



الوراثة الطبية / الكورس الأول

LAB3. Cell Division

Sawa University

College of health and medical techniques

Department of Medical Laboratories

Third Stage

جامعة ساوة الاهلية

كلية التقنيات الصحية والطبية

قسم تقنيات المختبرات الطبية

المرحلة الثالثة

محاضرة رقم 3

Lecture No. 3

الجانب العملي

Practical

تدريسي المادة : م.د.عباس علي منشد
م.م. مهند نجر اليونسي
م.م. ايات سلطان سيف

(INTRODUCTION)

- **LESSON OBJECTIVES**

By the end of this practical session, students should be able to:

- **Define cell division and cycle**
- **State cell division's purpose**
- **Describe the cell cycle**

Cell Division

What is Cell Division?

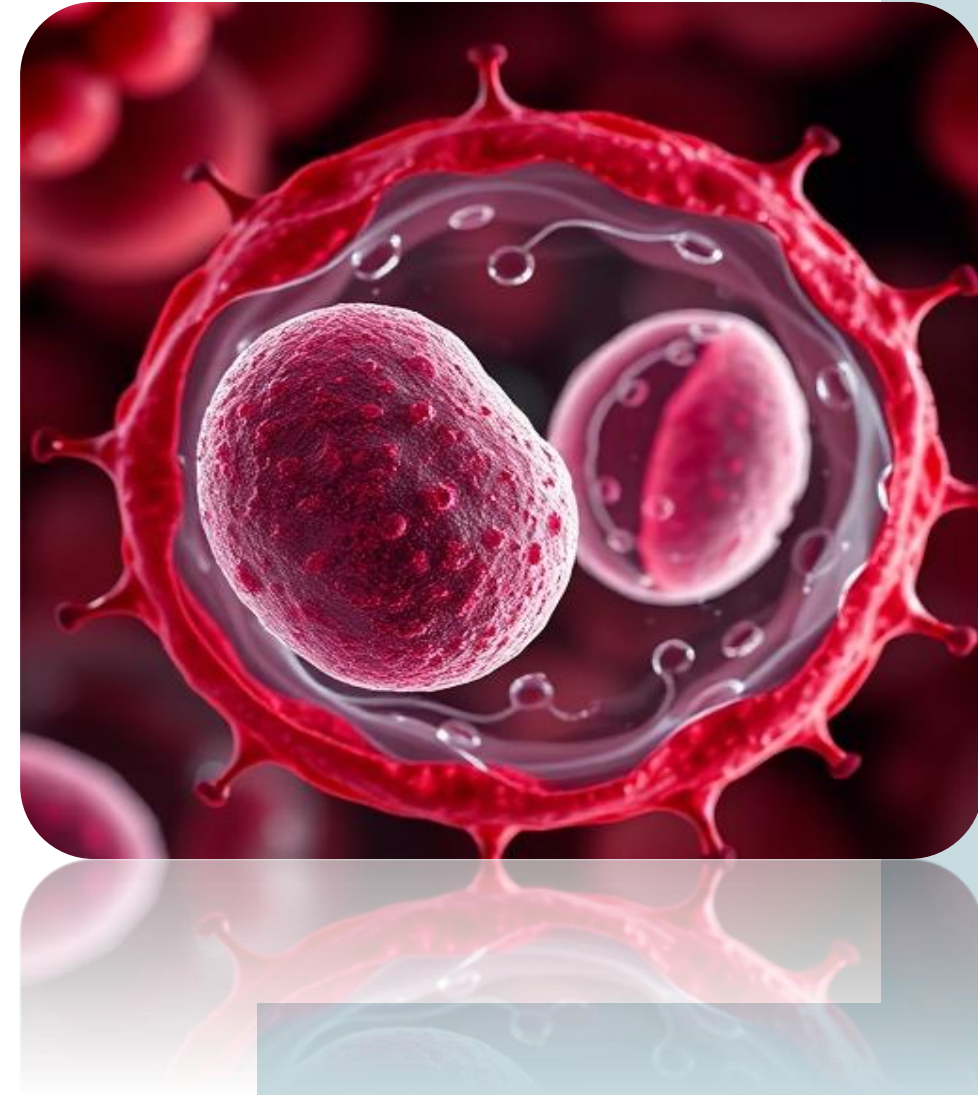
- **Cell division is the biological process where a single parent cell splits to form two or more new cells, known as daughter cells. This event typically takes place as a phase within the broader cell cycle.**
- **During this process, the original cell, referred to as the "parent" cell, divides to produce two "daughter" cells. This cycle of division and renewal continues repeatedly, driving growth and development.**

Cell Division

Why Do Cells Divide

Cells split for three fundamental purposes:

- **To enable the body to grow and mature over time**
- **To heal and replace tissues that are injured or have died**
- **To facilitate the process of reproduction, ensuring species continuation**



Cell Division

Higher organisms rely on two main methods for cell division:

1) Mitosis: This is the process through which cells create exact copies of themselves. Mitosis occurs in nearly all types of body cells, including those in the eyes, skin, hair, and muscles.

2) Meiosis: Unlike mitosis, meiosis produces sperm and egg cells that contain only half the usual number of chromosomes, resulting in haploid cells rather than identical duplicates.

CELL CYCLE

During the Cell Cycle

- **Cell grows.**
- **DNA is replication.**
- Mitotic cell division results in a daughter cell genetically identical to the parent.

The cell cycle is divided into two main stages:

Interphase: Once considered a dormant interval between divisions, this phase is now recognized as a period of intense cellular activity.

M Phase (Mitosis): This stage encompasses the actual process of cell division, which includes two critical events: cytokinesis (division of the cytoplasm) and karyokinesis (division of the nucleus).

The Cell Cycle

Interphase

The cell grows and copies its DNA

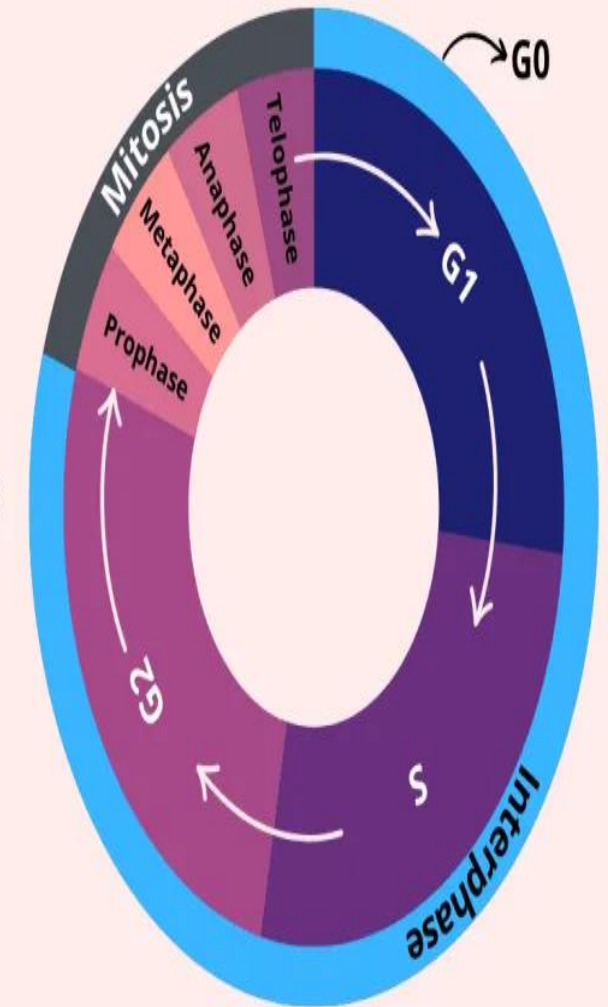
- **G₁:** Cell growth
- **S:** DNA synthesis
- **G₂:** More growth, preparation for mitosis

Mitosis

The cell divides its DNA and cytoplasm, forming two new cells

- **Prophase**
- **Metaphase**
- **Anaphase**
- **Telophase**

G₀: Resting state where the cell performs its functions and is not preparing to divide





FACTS AND STUFF BY D

Cell Division

Interphase

Non-dividing state

with 3 sub-stages:

Gap 1 : cell grows in size— organelles replicated

Synthesis : replication of DNA— synthesis of proteins associated with DNA

Gap 2 : synthesis of proteins

associated with mitosis

Mitosis

Mitosis

4 sub-phases:

1st– Prophase

2nd – Metaphase

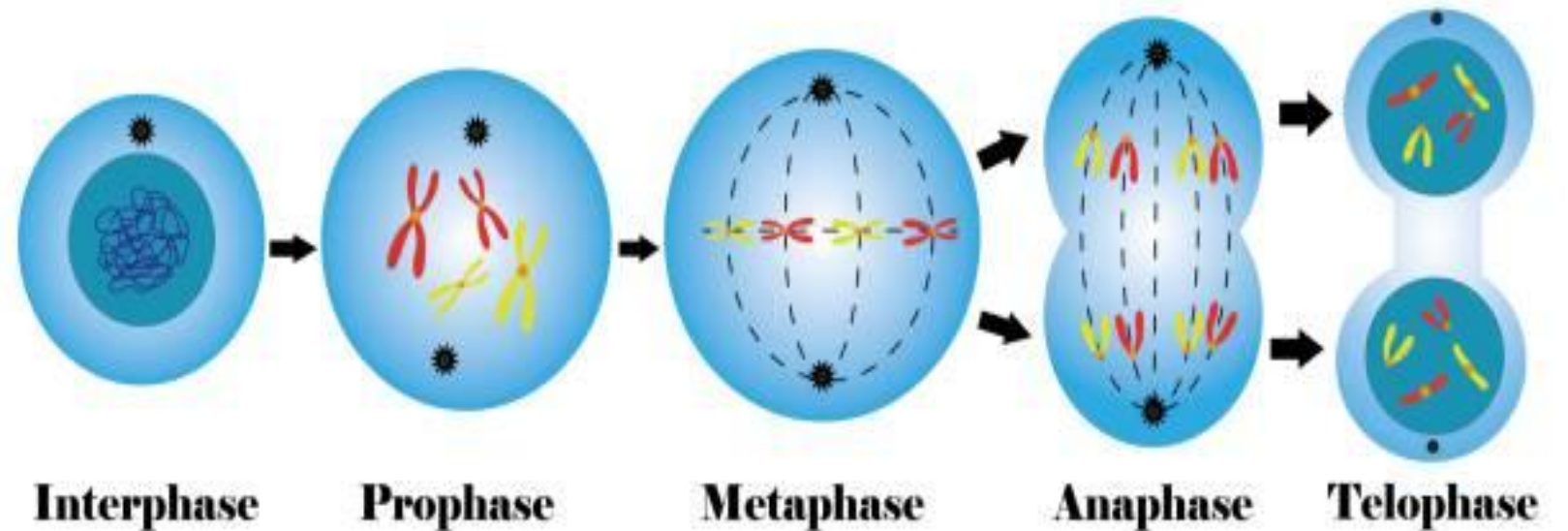
3rd – Anaphase

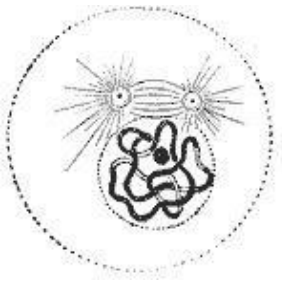
4th – Telophase

followed by

Cytokinesis

MITOSIS





1. Prophase

chromatin nucleus

condensing
chromosomes

nucleolus

centrioles

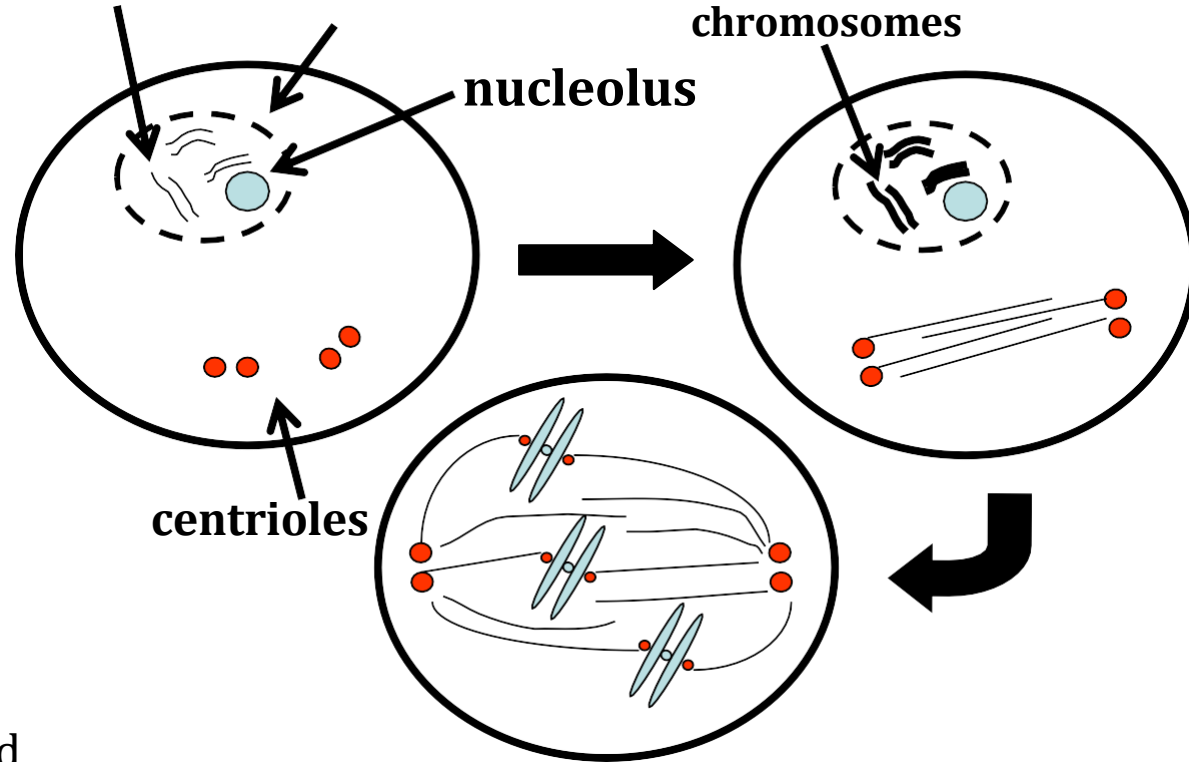
Three Major Events

1. chromosomes
condense

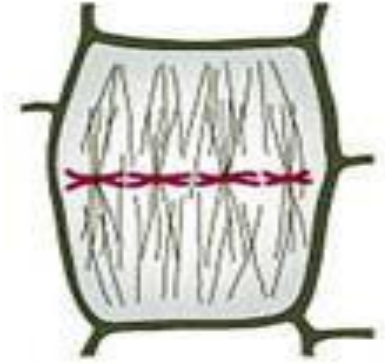
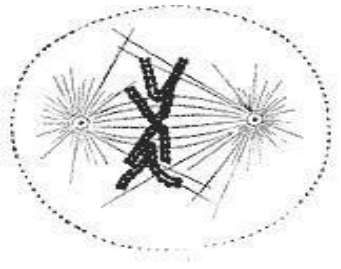
2. spindle fibers form

1. (spindle fibers are specialized microtubules radiating out from centrioles)

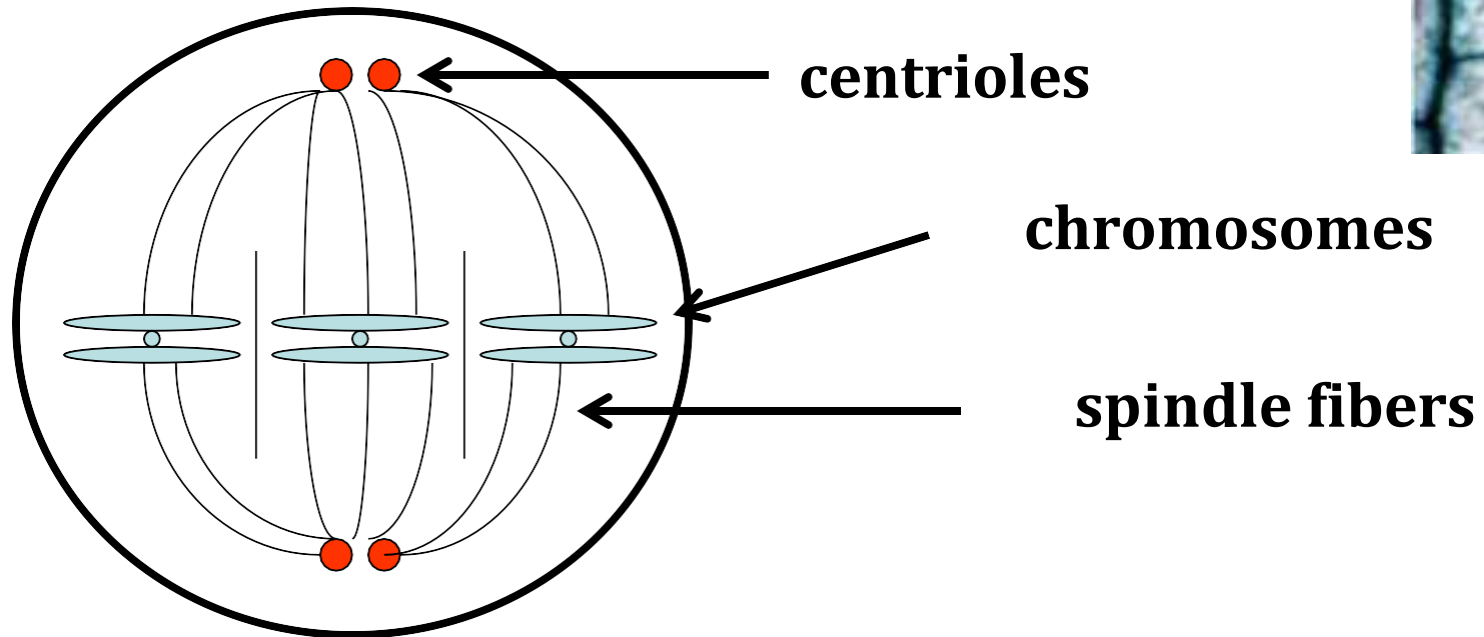
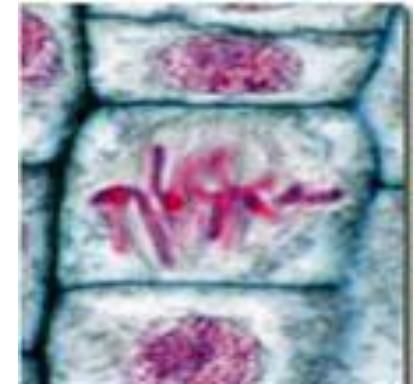
3. chromosomes are captured by spindle

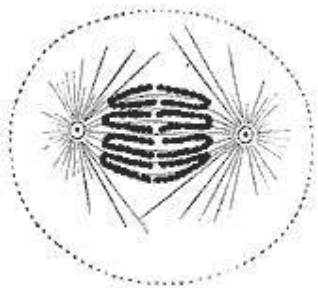


2. Metaphase



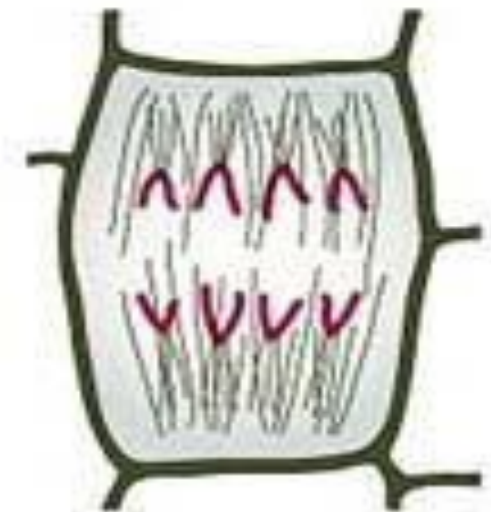
- chromosomes align along the equator of the cell, with one chromatid facing each pole

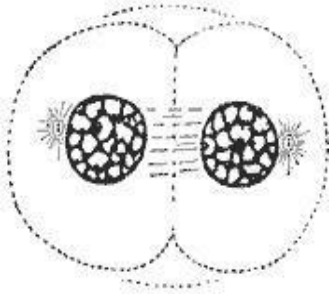




3. Anaphase

- sister chromatids separate
- spindle fibers attached to kinetochores **shorten** and **pull** chromatids towards the poles.
- free spindle fibers **lengthen** and **push** the poles of the cell apart





4. Telophase

- spindle fibers disintegrate
- nuclear envelopes form around both groups of chromosomes
- chromosomes revert to their extended state
- cytokinesis occurs, enclosing each daughter nucleus into a separate cell

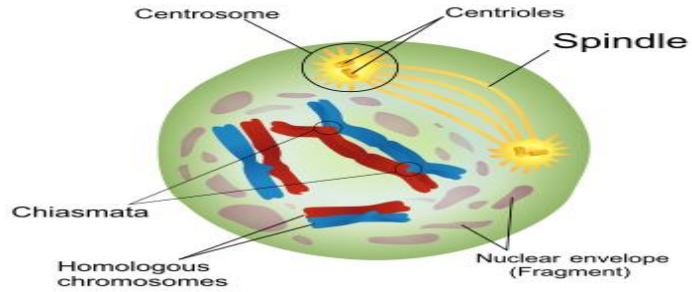


Meiosis (Overview)

Medical genetics

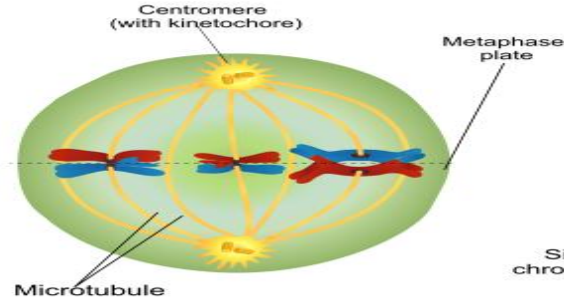
- Occurs in **germ cells (sperm, oocytes)**.
- Produces **4 genetically unique haploid cells**.
- Involves **2 divisions (Meiosis I & II)**.
- Introduces genetic variation through:
 1. **Crossing over (Prophase I)**.
 2. **Independent assortment of chromosomes**.
- **Meiosis I:**
Reduction division ($2n \rightarrow n$). **Homologous chromosomes separate**.
- **Meiosis II:**
Similar to mitosis, but starting with haploid cells.
- Final product: 4 haploid gametes, each genetically different.

Prophase I



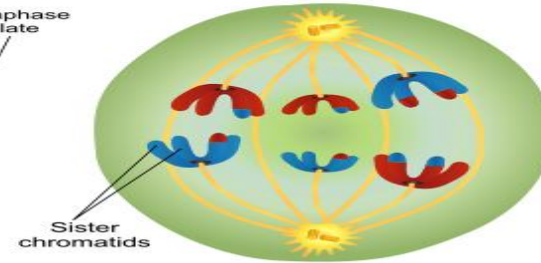
The chromosomes condense, and the nuclear envelope breaks down. Crossing-over occurs.

Metaphase I



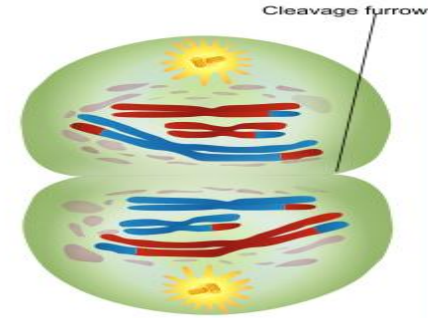
Pairs of homologous chromosomes move to the equator of the cell.

Anaphase I



Homologous chromosomes move to the opposite poles of the cell.

Telophase I & cytokinesis

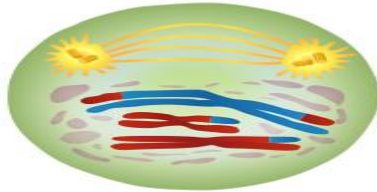


Chromosomes gather at the poles of the cells. The cytoplasm divides.

Meiosis I: Reductional Phase

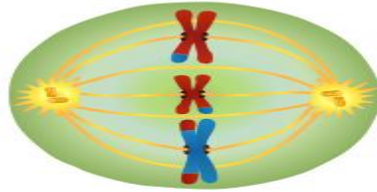


Prophase II



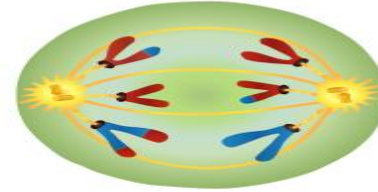
A new spindle forms around the chromosomes.

Metaphase II



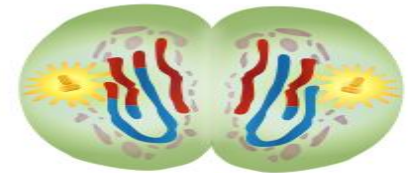
Metaphase II chromosomes line up at the equator.

Anaphase II

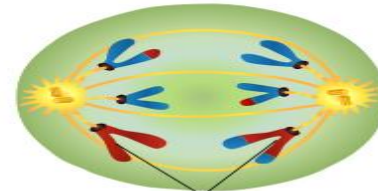
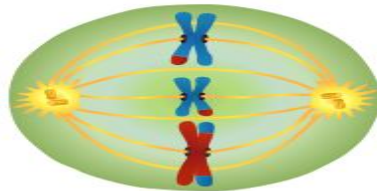
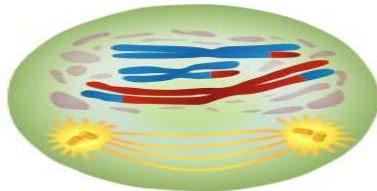


Centromeres divide. Chromatids move to the opposite poles of the cells.

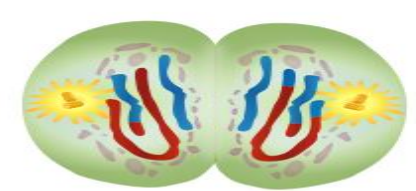
Telophase II & cytokinesis



A nuclear envelope forms around each set of chromosomes. The cytoplasm divides.

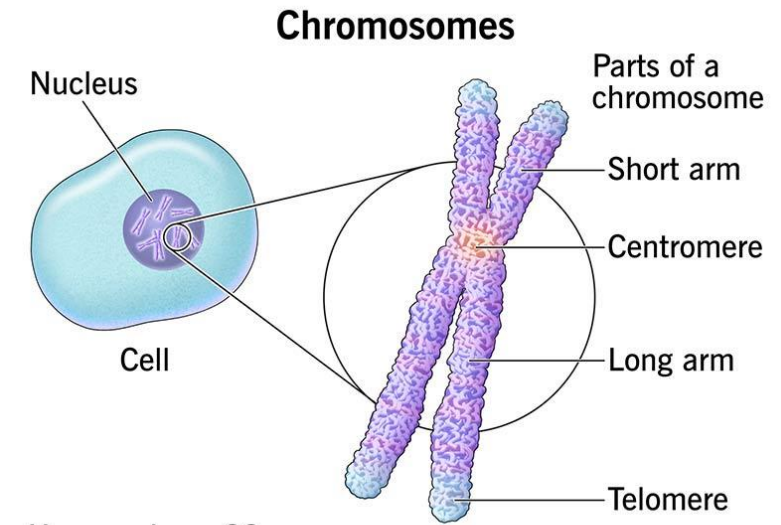
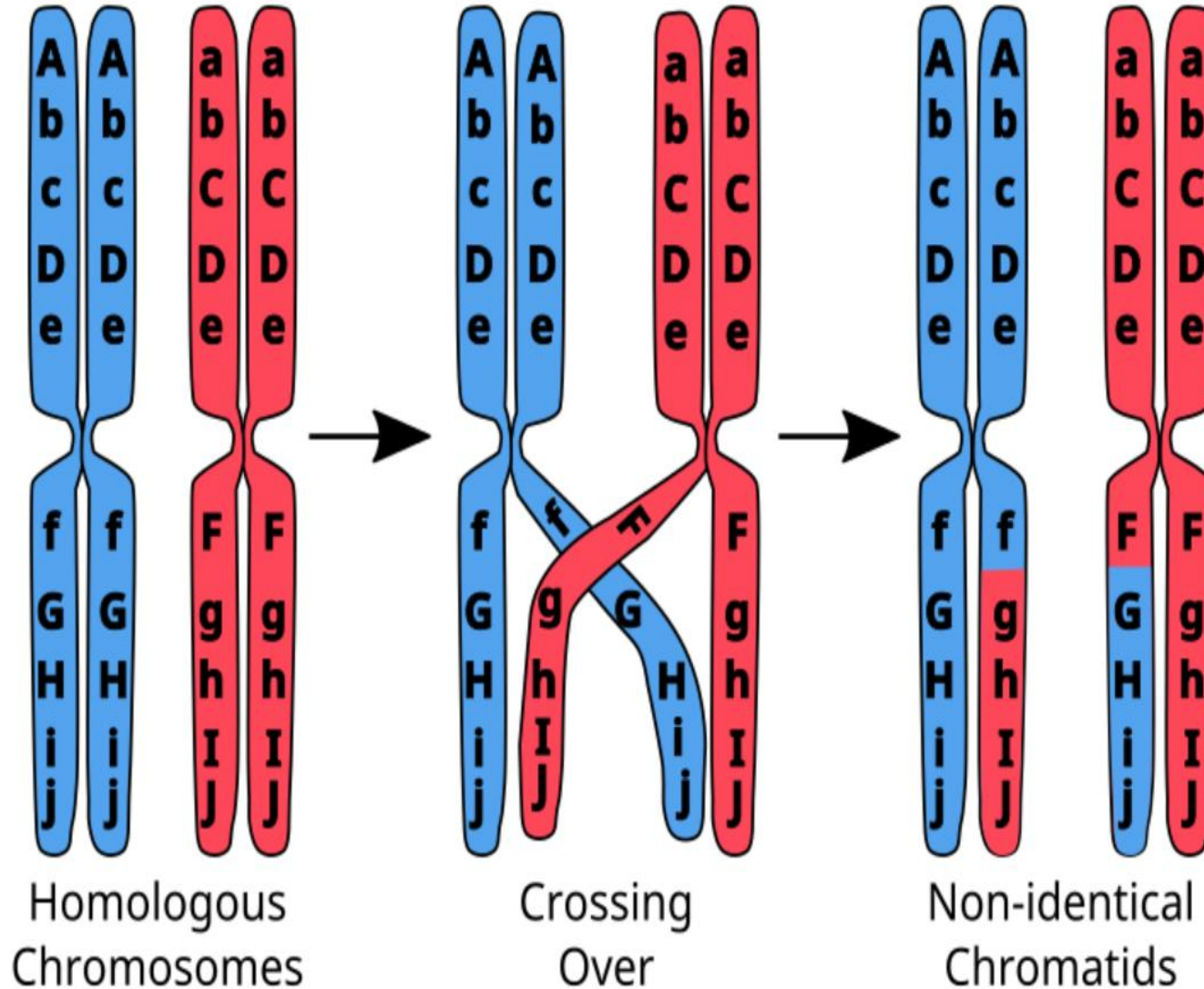


Sister chromatids separate

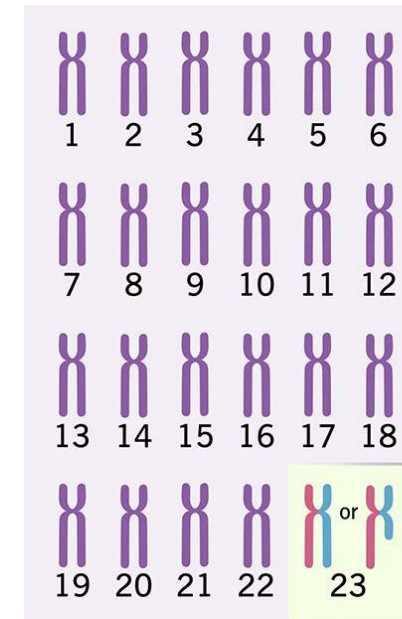


Meiosis II

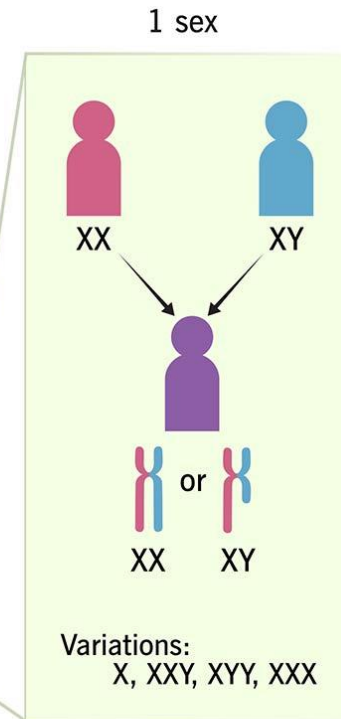
Meiosis (Overview)



Humans have 23 pairs of chromosomes:
22 autosomal



Variations:
Extra 13th, 18th, or 21st chromosome



Meiosis VS. Mitosis

Mitosis vs. Meiosis

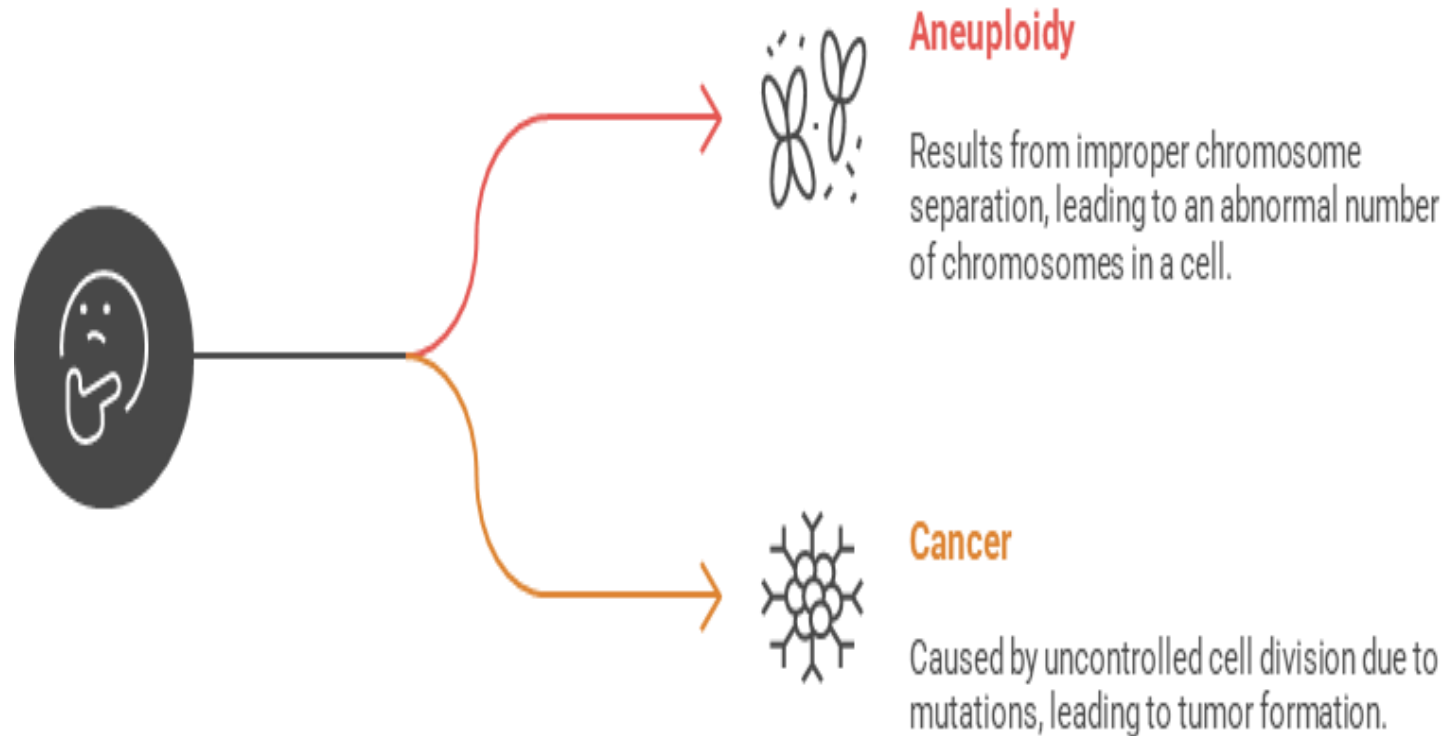
Feature	Purpose	Number of Divisions	Daughter Cells	Chromosome Number	Crossing Over	Homologous Pairing
Mitosis	Growth, repair, asexual reproduction	One	Two, identical	Same ($2n \rightarrow 2n$)	Does not occur	Absent
Meiosis	Sexual reproduction	Two	Four, different	Halved ($2n \rightarrow n$)	Occurs	Present

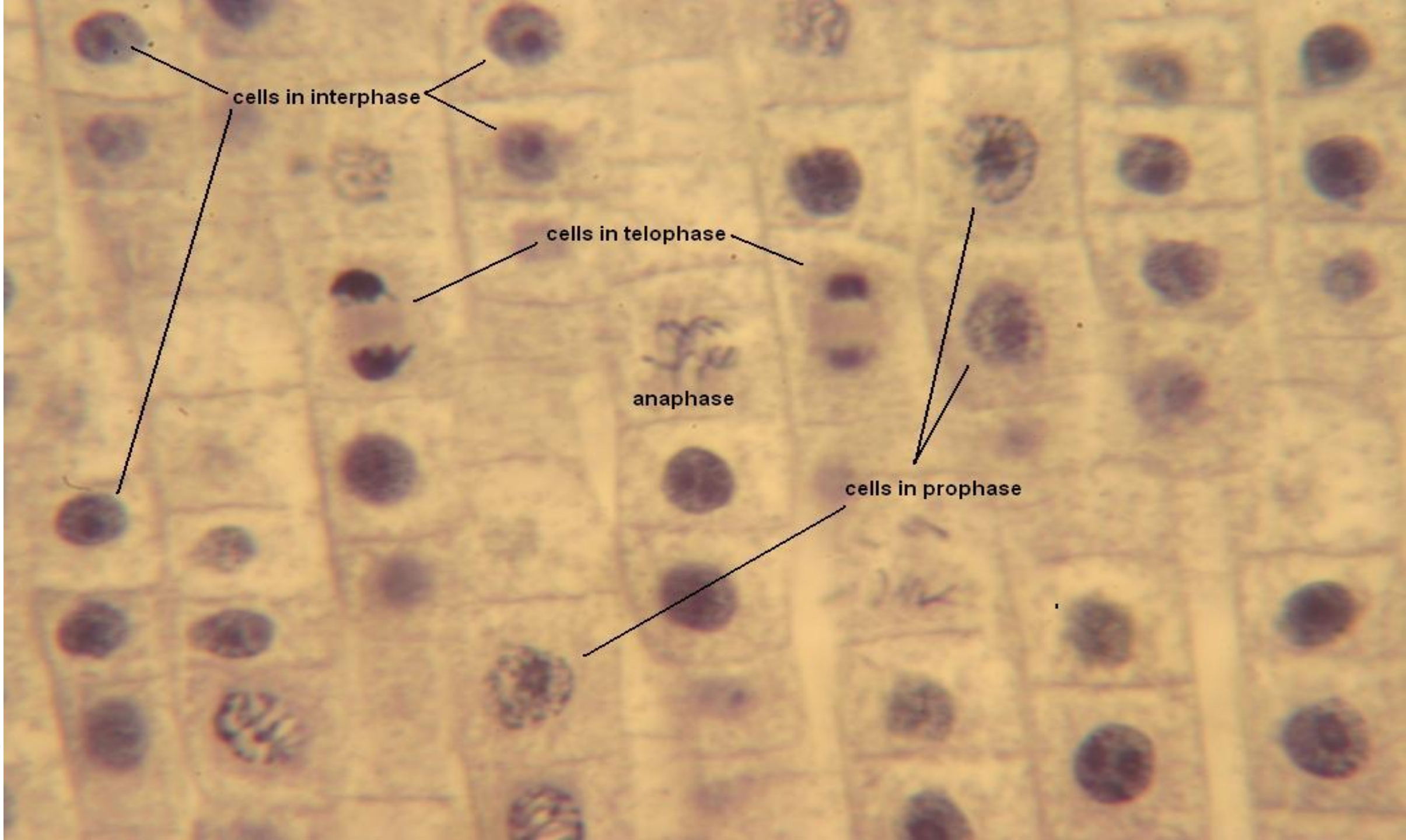
Errors in cell division

Errors in cell division can lead to various problems, including:

- **Aneuploidy:** An abnormal number of chromosomes in a cell. This can occur if chromosomes fail to separate properly during mitosis or meiosis (nondisjunction).
- **Cancer:** Uncontrolled cell division can lead to the formation of tumors. Mutations in genes that regulate cell division can disrupt the normal cell cycle, causing cells to divide uncontrollably.

What are the potential errors in cell division?





cells in interphase

cells in telophase

anaphase

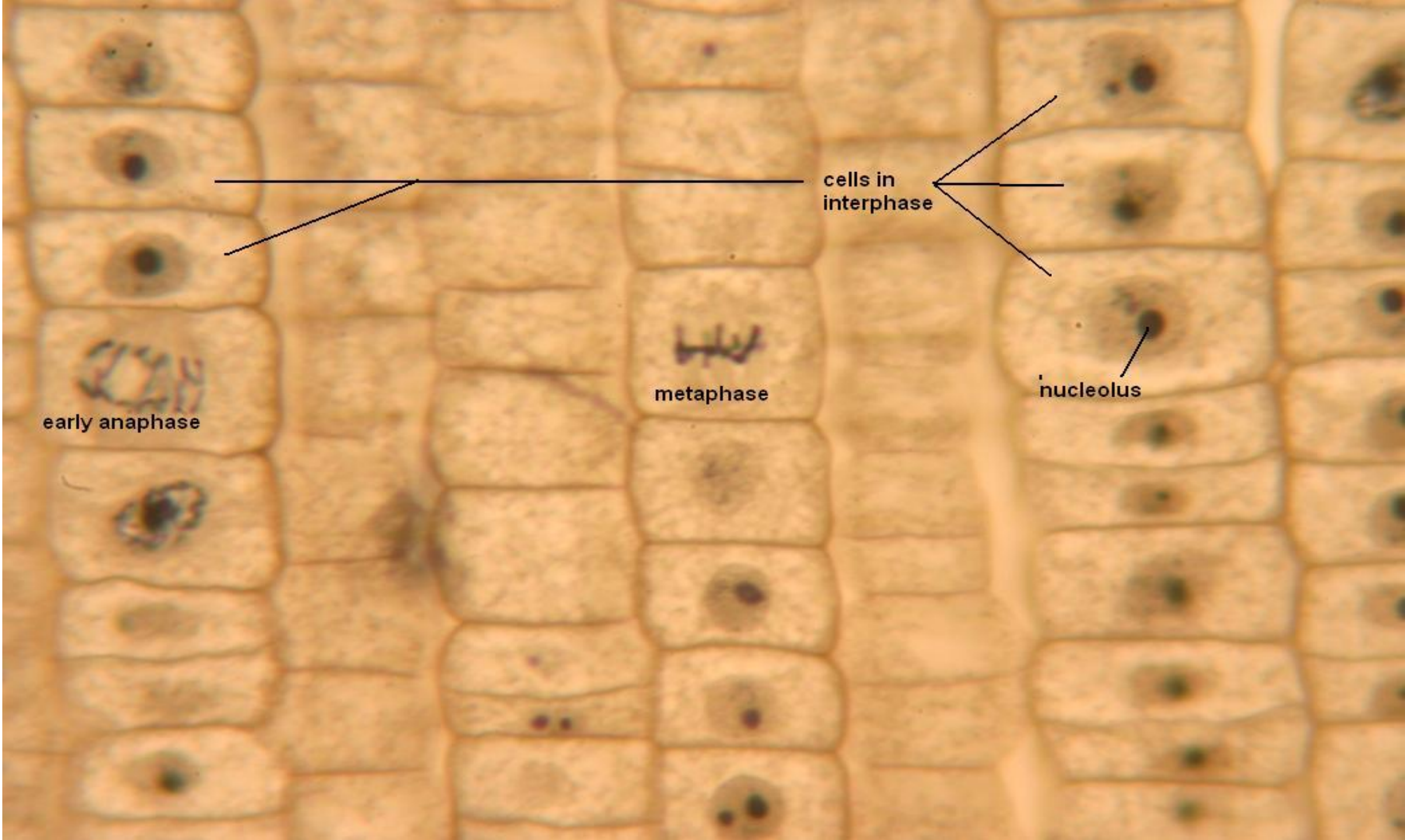
cells in prophase

prophase

cells in telophase

cell plate





early anaphase

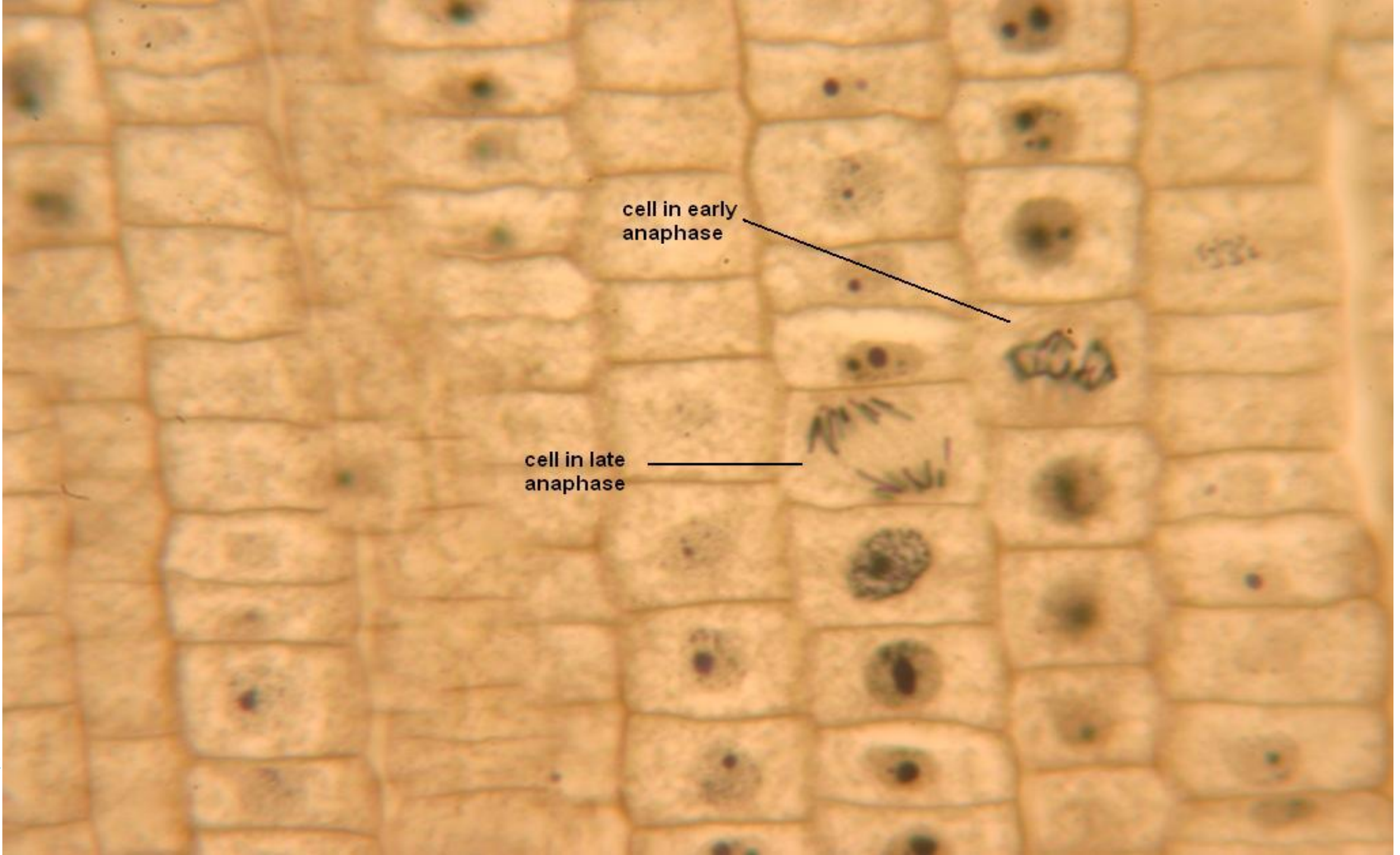
metaphase

cells in
interphase

nucleolus

cell in early
anaphase

cell in late
anaphase



REFERENCE

- **Nabor, Murray W., INTRODUCTION TO BOTANY, 2004, Pearson Education (Benjamin Cummings).**
- **CK-12: https://www.ck12.org/biology/cell_division/lesson/Cell-Division-BIO/**
- **Image Credit: Mariana Ruiz Villarreal (LadyofHats), CK-12 Foundation, CC BY-NC 3.0**

QUIZ

1. What is the main difference between mitosis and meiosis?
2. What are the potential errors in cell division?

Any questions?

*Thank
You*